REMARKS

The application has been reviewed in light of the Office Action dated March 31, 2003. Claims 1-6 and 13-22 were pending in this application, with claims 7-12 having been withdrawn by the Patent Office from consideration. Claim 1 has been cancelled, without prejudice or disclaimer, and claims 2-6, 13, and 19-22 have been amended hereby to present the clsim in a better form for examination. Accordingly, claims 2-6 and 13-22, with claims 13, 19, and 20 being the independent claims, are presented for examination. It is submitted that no new matter has been added and no new issues have been raised by the present amendment.

Claims 1-6, 13-18, 20, and 21 were rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which the applicant regards as the invention.

The claims have been amended hereby to clarify the subject matter which Applicant regards as the invention.

Accordingly, reconsideration and withdrawal of the rejection under 35 U.S.C. § 112, second paragraph, are respectfully requested.

Claims 1-6 and 13-22 were rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over U.S. Patent No. 6,456,640 to Okumura in view of U.S. Patent No. 6,118,800 to Kidoguchi et al.

Applicant has carefully considered the Examiner's comments and the cited art, and respectfully submits that the claims are patentable over the cited art, for at least the following reasons.

Mixed crystals have properties of particular importance in the field of semiconductors. The subject application embodies Applicant's recognition of such properties.

An example of a nitrogen-containing mixed crystal is GaNAs, which is a mixed crystal of GaAs and GaN, and includes N and As as group-V elements. A relationship between the band gap energy and the N content of the GaNAs crystal is illustrated demonstratively in the figure attached hereto as Exhibit 1.

In the figure attached as Exhibit 1, the N content is represented along the x axis and the band gap energy is represented by the y axis. Band gap values for GaAs and GaN are represented at positions along the x axis corresponding to an N content of N=0, and an N content of N=1, respectively. A theoretical linear relationship between the band gap and the N content, shown by the dotted line in Exhibit 1 implies an intermediate band gap between the band gaps of GaAs and GaN.

In practice, however, the line describing the band gap of GaNAs is an upwardly-parabolic, or "U-shaped," line, represented by the solid line in Exhibit 1. It can be seen from Exhibit 1 that when the N content is low, the GaNAs crystal has a band gap smaller than that of GaAs.

Another example of a nitrogen-containing mixed crystal is GaNP, which is a mixed crystal of GaP and GaN. Although not reproduced here, a graphical representation of the band gap of GaNP over the N content would also demonstrate an upwardly-parabolic "U-shape" similar to that described above. Additionally, InGaNAs (a mixed crystal of InGaAs and InGaN), and GaInNP (a mixed crystal of GaInP and GaInN) share this band gap characteristic.

By using a mixed crystal including a group-V element and nitrogen, a saturable layer having a band gap slightly different from that of the active layer while having a lattice constant almost the same as that of the active layer can be easily formed.

Furthermore, mixed crystals including nitrogen and another group-V element have shortened carrier lives.

In the device of the claimed invention, a saturable absorbing layer is formed having the characteristics of the mixed crystal including nitrogen and another group-V element.

For example, independent claim 13 relates to a semiconductor device. The device includes a semiconductor substrate of a first conductivity type, a first cladding layer of the first conductivity type formed on the semiconductor substrate, an active layer formed on the first cladding layer, a second cladding layer of a second conductivity type formed on the active layer, and a saturable absorbing layer formed on at least portions of at least one of the first cladding layer and the second cladding layer. The saturable absorbing layer is a mixed crystal of nitrogen (N) with another group-V element and is formed to have a band gap energy either approximately the same as, or slightly smaller than, the active layer.

Okumura, as understood by Applicant, relates to a gallium nitride type semiconductor laser device. The device includes a substrate and a layered structure formed on the substrate. The layered structure at least includes an active layer of a nitride type semiconductor material which is interposed between a pair of nitride type semiconductor layers each functioning as a cladding layer or a guide layer.

The Office Action states that Okumura discloses a conventional self-pulsating laser device having a substrate, a cladding layer, an active layer, another cladding layer, and a saturable absorbing layer made of InGaN (see Office Action, p. 3, lns. 13-16).

As understood by Applicant, the semiconductor laser device disclosed by Okumura includes an n-SiC substrate, an n-AlN buffer

layer, an n-$Al_{0.15}Ga_{0.85}N$ cladding layer, an $In_{0.15}Ga_{0.85}N$ active layer, a p-$Al_{0.15}Ga_{0.85}N$ first p-type cladding layer, a p-$In_{0.2}Ga_{0.8}N$ saturable absorbing layer, an n-$Al_{0.25}Ga_{0.75}N$ current blocking layer, a p-$Al_{0.15}Ga_{0.85}N$ second p-type cladding layer, a p-GaN cap layer, a p-GaN contact layer, and p-side and n-side electrodes (see Okumura, col. 1, lns. 53-63; Fig. 12).

As understood by Applicant and as noted in the Office Action, the saturable absorbing layer of Okumura consists of InGaN. That is, Okumura is seen to include only N as the group-V element. Applicant finds no teaching or suggestion in Okumura of a saturable absorbing layer formed on at least portions of at least one of the first cladding layer and the second cladding layer, wherein the saturable absorbing layer is a mixed crystal of nitrogen (N) with another group-V element and is formed to have a band gap energy either approximately the same as, or slightly smaller than, the active layer, as recited in amended claim 13.

The Office Action also acknowledges that Okumura is silent regarding the band gap of the saturable absorber (see Office Action, p. 3, ln. 17). Kidoguchi et al. is apparently cited to show the missing element.

Kidoguchi et al., as understood by Applicant, relates to a semiconductor laser and cleaving method. The semiconductor laser has an active layer and a cladding structure interposing the active layer. The cladding structure includes a saturable absorbing layer formed of InGaAsP.

As understood by Applicant, independent cladding layers in Kidoguchi et al. are located adjacent to a saturable absorbing layer (see Kidoguchi et al., Figs. 1A, 8). That is, the saturable absorbing

layer of Kidoguchi et al. is in direct contact with the cladding layers.

The Office Action states that Kidoguchi et al. discloses a self-pulsating laser device including a saturable absorbing layer having a band gap smaller than that of the active layer (see Office Action, p. 3, lns. 18-22). As understood by Applicant, however, the material constituting the saturable absorbing layer of Kidoguchi et al. does not include N.

The cited art simply does not recognize the advantageous characteristics of a saturable absorbing layer which is a mixed crystal including nitrogen and another group-V element.

Applicant finds no teaching or suggestion in the cited art of a saturable absorbing layer formed on at least portions of at least one of the first cladding layer and the second cladding layer, wherein the saturable absorbing layer is a mixed crystal of nitrogen (N) with another group-V element and is formed to have a band gap energy either approximately the same as, or slightly smaller than, the active layer, as recited in amended independent claim 13.

Therefore, for at least the foregoing reasons, it is respectfully submitted that amended independent claim 13 is patentably distinct over the cited art. Independent claims 19 and 20 are believed to be patentable over the cited art for at least similar reasons.

The effect of the claimed invention can be produced when the saturable absorber is a mixed crystal including nitrogen and another group-V element. Therefore, the devices such as Kidouchi, which does not include nitrogen, and Okumura, which includes only nitrogen as a group V element, cannot solve the problem which is solved by the claimed invention.

The Office is hereby authorized to charge any additional fees that may be required in connection with this amendment and to credit any overpayment to our Deposit Account No. 03-3125.

If a petition for an extension of time is required to make this response timely, this paper should be considered to be such a petition, and the Commissioner is authorized to charge the requisite fees to our Deposit Account No. 03-3125.

If a telephone interview could advance the prosecution of this application, the Examiner is respectfully requested to call the undersigned attorney.

Entry of this amendment and allowance of this application are respectfully requested.

Respectfully submitted,

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